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Original Article

Postoperative Facial Nerve Palsy of Cerebello-Pontine Angle Vestibular Schwannoma Surgery by retro-sigmoid retro-mastoid sub-occipital approach in a single unit in a tertiary care hospital, Dhaka

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Abstract:

Background: Postoperative facial nerve palsy after CPA vestibular schwannoma surgery via the retro-sigmoid retro-mastoid sub-occipital route is a well-recognized complication. Its occurrence depends on tumor characteristics, surgical technique, and intraoperative nerve preservation strategies. Advances in microsurgical dissection and intraoperative neuro-monitoring have improved outcomes, but some risk remains inherent due to the complex anatomy of the CPA region. Presenting symptoms, treatment considerations, and postoperative facial nerve palsy are strongly related to the extension of vestibular schwannomas (VS). Ongoing research aims to optimize surgical techniques and postoperative management to improve facial nerve preservation and patient outcomes.

Methods: The study included 130 patients diagnosed with cerebello-pontine angle vestibular schwannoma who underwent surgical resection via the retro-sigmoid retro-mastoid sub-occipital approach at our institution between January 2017 and May 2022. All surgeries were performed using this posterior fossa route aiming for maximal tumor removal while aiming to preserve nerve function. Postoperative facial nerve function was assessed using the House-Brackmann (HB) grading system at specified intervals to evaluate the degree of facial palsy and recovery. Hearing function was evaluated pre- and post-operatively using pure tone audiometry (PTA). Data collected included patient demographics, tumor size and location, intraoperative findings, and postoperative nerve status. The goal was to analyze the incidence, severity, and recovery patterns of facial nerve palsy following this surgical approach, providing insights into nerve preservation and surgical outcomes.

Results: Most patients had large tumors and had no useful hearing (75.38%), had disabling cerebellar ataxia (84.61%) and presented with features of raised intracranial pressure (46.15%). Complete tumor excision was carried out 92.30% and anatomical preservation of facial nerve was achieved in 87.50% cases. Hearing preservation was achieved in eight (6.2%) patients.

Conclusions: Postoperative facial nerve palsy is a significant and common complication associated with the surgical removal of vestibular schwannomas located in the cerebello-pontine angle (CPA). Due to anatomical relationship, surgical manipulation or tumor dissection can put the facial nerve at risk of injury. Facial nerve palsy can range from mild weakness (House-Brackmann grade II) to complete paralysis (grade VI), affecting facial expression, eyelid closure, speech, and oral competence, thereby impacting the patient's quality of life. The incidence of postoperative facial nerve dysfunction varies depending on tumor size, surgical technique, and surgeon experience, but it remains a key concern in vestibular schwannoma surgeries. Hearing preservation is difficult in larger tumors. Primary microsurgical resection is an appropriate management option for large VS. In our experience, this goal can be achieved safely and successfully by using the retromastoid retrosigmoid sub-occipital approach.

Key Words: Vestibular schwannomas, Cerebello-pontine angel, Retrosigmoid approach, Facial nerve preservation.

Introduction:

Vestibular schwannomas, also known as acoustic neuromas, are benign tumors arising from the Schwann cells of the vestibular portion of the eighth cranial nerve within the cerebello-pontine angle (CPA). The annual incidence of VS is 1–2:100,000 making it the third most common benign intracranial tumor. Surgical resection remains a mainstay treatment, particularly for sizable tumors or when indicated by growth, symptoms, or patient preference.

One of the most significant and challenging postoperative complications associated with CPA vestibular schwannoma surgery is facial nerve palsy. The facial nerve (cranial nerve VII), which traverses the CPA region in close proximity to the tumor, is at risk of injury during tumor removal due to its anatomical course and the tumor's location.

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Facial nerve function is vital for facial expression, eyelid closure, speech, and oral competence. Postoperative facial nerve palsy can significantly impact a patient's quality of life, leading to cosmetic deformities, functional impairments, and psychological effects. Therefore, preserving or restoring facial nerve integrity is a primary goal during surgical management.

The incidence of postoperative facial nerve palsy varies depending on tumor size, surgical approach, surgeon experience, and intraoperative nerve monitoring. It can range from temporary paresis to permanent paralysis. Typically, facial nerve function post-surgery is graded using the House-Brackmann scale, with grades I-II considered good function and grades V-VI indicating severe paralysis.

Facial nerve injury during surgery may result from mechanical trauma or stretching, Thermal injury from cautery, ischemia due to compromised blood supply, direct nerve transection or avulsion, edema-induced compression. . Surgical treatment of VSs results in permanent facial weakness in 10–40% of patients. Understanding the risks and mechanisms of postoperative facial nerve palsy in CPA vestibular schwannoma surgeries is essential for surgical planning, intraoperative nerve preservation, and postoperative management aimed at optimizing functional outcomes.
The aim of VS surgery:
The aim of vestibular schwannoma (acoustic neuroma) surgery is to remove the tumor completely or reduce its size to alleviate symptoms, preserve neurological function—particularly facial nerve function—and minimize surgical complications. The primary goals include:

- Achieving maximal tumor resection while preserving the patient's hearing and facial nerve integrity.
- Preventing or reducing postoperative complications such as cerebrospinal fluid leaks, infections, and neurological deficits.
- Improving or stabilizing the patient's quality of life by alleviating symptoms like hearing loss, tinnitus, balance disturbances, and neurological impairments associated with the tumor.

Overall, the surgical approach seeks to balance effective tumor removal with the preservation of critical neural functions, especially the facial nerve, to ensure optimal postoperative outcomes.
Maximum safe resection without causing additional neurological defects in the function of adjacent cranial nerves. The preservation of facial nerve function.

The objective:
The objectives regarding postoperative facial nerve palsy in cerebello-pontine angle vestibular schwannoma surgery focus on minimizing nerve injury, preserving facial nerve function, and promoting recovery. Specifically, they aim to:

- Prevent or reduce the severity of facial nerve palsy through meticulous surgical techniques and nerve preservation strategies.
- Early detection and management of facial nerve deficits postoperatively to facilitate timely interventions.
- Optimize nerve function recovery via rehabilitation and medical therapies.
- Improve overall surgical outcomes by balancing tumor removal with nerve preservation.
- Enhance patient quality of life by maintaining facial symmetry and function, and providing appropriate counseling and support.

These objectives collectively strive to ensure the best possible facial nerve outcomes following surgery for vestibular schwannomas
Materials and methods:
Study design: A retrospective study
Study duration: January, 2017 to May, 2022 (65 months).
Patient Selection: The cohort comprised 130 patients diagnosed with cerebello-pontine angle (CPA) vestibular schwannoma, confirmed through imaging studies and clinical evaluation. All patients were candidates for surgical resection and provided informed consent.
Study place: A single unit, Department of Neurosurgery, National Institute of Neurosciences and Hospital, Sher-E-Bangla Nagar, Dhaka
Surgical Approach: All procedures were performed using the retro-sigmoid retro-mastoid sub-occipital approach, a standard posterior fossa route that offers direct access to the CPA while aiming to preserve cranial nerve function.
Assessment of Facial Nerve Function: Postoperative facial nerve function was evaluated using the House-Brackmann (HB) grading system, which classifies facial nerve palsy severity on a scale from I (normal) to VI (total paralysis). Assessments were conducted at predefined intervals post-surgery to monitor recovery or deterioration.
Hearing Evaluation: Hearing function was assessed pre- and post-operatively using pure tone audiometry (PTA), following standardized protocols to determine the degree of hearing preservation or loss.

Data Collection and Analysis: Data regarding patient demographics, tumor characteristics, intraoperative findings, and postoperative outcomes were collected. Statistical analyses were performed to identify factors associated with postoperative facial nerve palsy, including the severity and recovery patterns.

This methodology provides a comprehensive framework to evaluate the incidence and determinants of postoperative facial nerve palsy following the retro-sigmoid approach for vestibular schwannoma, facilitating insights into surgical outcomes and nerve preservation strategie

Radiologic evaluation:

High-resolution bone window computed tomography (CT) studies

MRI of the brain with contrast

Follow-up MRI was performed in all patients three months after the surgery to exclude residual tumor, and then every year to exclude recurrence.

Note: Giant tumors -- larger than 40 mm; Large tumors -- up to 25 to 40 mm

Small tumors -- up to 10 to 25 mm

Subtotal resection (STR): Residual contrast enhancement along facial nerve or brainstem with a diameter exceeding 5 mm.

Near-total resection (NTR): Residual contrast enhanced tissue measuring less than 5 mm

Operative procedure:

All the patients were operated via the retro-mastoid sub-occipital approach, with the patient positioned in the park bench position.

Cavintron ultrasonic aspirator was used in few cases. The facial nerve stimulator was used utilized in some cases

The intrameatal component of tumor was removed and the lateral aspect of the intrameatal facial nerve defined, after drilling the roof internal acoustic meatus (IAM).

A piece of muscle was used to seal the drilled IAM in all patients.

Mean operation time was 6.25 hours (range: 2.5–10 hours).

Follow up:

All the patients were followed up at 6 weeks, at 3 months, at 6months and yearly thereafter.

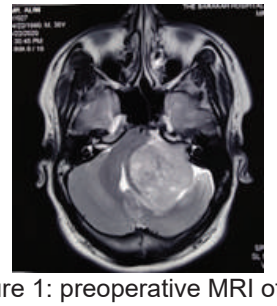

Figure 1: preoperative MRI of VS

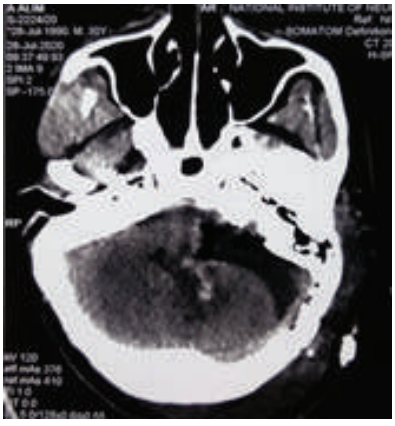

Figure 2: Postoperative CT scan of VS

Figure 3: Preoperative MRI of Cystic VS

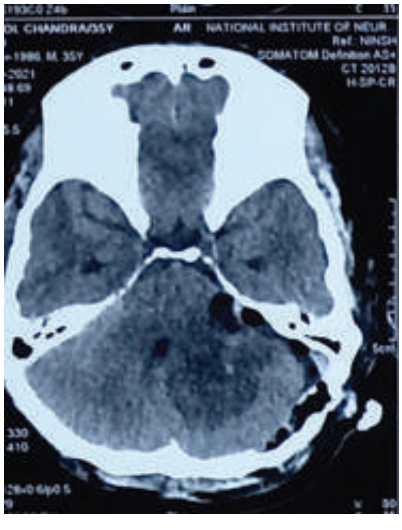

Figure 4: Postoperative CT scan of VS of same Patient

Results:

Sex distribution:

The sex distribution among patients undergoing cerebello-pontine angle vestibular schwannoma surgery is as follows: 56(43.1%) males and 74(56.9%) females.

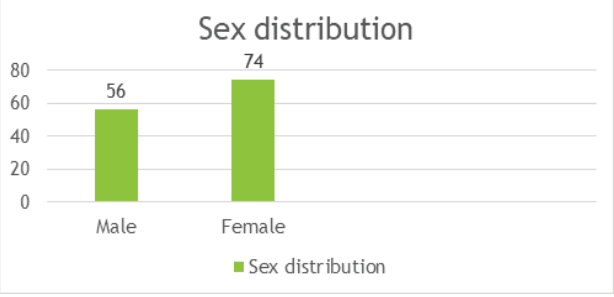

Fig.-3: Distribution of patients by sex

Distribution of Location:

52 (40%) tumors were right-sided and 78 (60%) were left-sided.

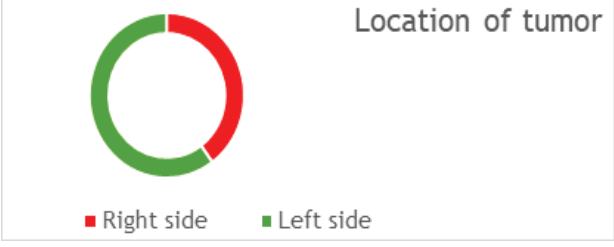

Fig.4: Distribution of location of tumor

Patient ages at diagnosis were distributed as follows:

Category 1: 15–30 years: 40 (30.76%)
Category 2: 31–45 years: 45 (34.61%)
Category 3: 46–60 years: 37 (28.46%)
Category 4: 61–75 years: 8 (6.15%)

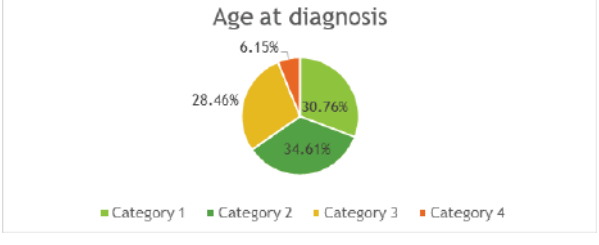

Fig.5: Category of age at diagnosis of tumor

Table – I: Pre-operative cranial nerve and neurological deficits in patients with vestibular Schwannoma:

Neurological deficits	Number	(%)
Hearing loss (no useful hearing)	98	75.38
Cerebellar signs	110	84.61
Trigeminal dysfunction	72	55.38
Facial nerve paresis	74	56.92
Papilledema Secondary optic atrophy	60	46.15
Lower cranial nerve paresis	42	32.30

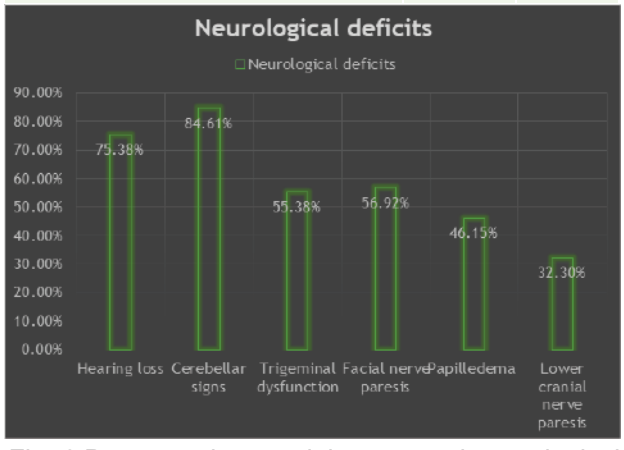

Fig.-6:Pre-operative cranial nerve and neurological deficits in patients with vestibular Schwannoma: Regarding the duration of the chief complaint at diagnosis: 15 (11.53%) patients had the symptom for less than six months, 26 (20%) for six months to one year, and 79 (60.76%) for more than one year.

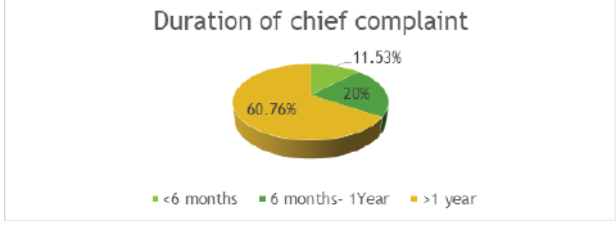

Fig.-7: Distribution of duration of chief complaints

Pre or postoperative surgical procedures:

Thirteen patients (10%) underwent ventriculoperitoneal shunt procedure prior to definitive surgery. Eight patients (6.15%) required EVD (External Ventricular Drainage) surgery in the post-operative period. Four patients (3%) underwent Ventriculoperitoneal shunt procedure after definitive surgery. Complete excision of the VS along with intra-metal portion was achieved in 92.30% (120/130) of patients.

Out of the ten patients in whom complete excision could not achieved; Seven patients had tumor adhere to brainstem and in three patients the tumor was adhere to facial nerve (part of the tumor was left to avoid injury). In one patient, only a subtotal removal was possible due to massive intra-operative hemorrhage. Facial nerve anatomically preserved in 87.50% (105/120) patients with complete tumor excision. Ten patients died in post-operative period. The facial nerve preservation rates were 80.00% for giant size VS and increased rates were observed with tumors of smaller sizes (91.48% for large and 100% for medium size). Further the functional status of the facial nerve at follow up were better in patients with relatively smaller tumors who had mild grade facial paresis (H&B Grade 1and 2) pre-operatively.

Table- II: Anatomical preservation of facial nerve in patients with complete excision in different tumor sizes:

Tumor category	Patients with complete removal	Anatomical preservation of 7th nerve	(%)
Medium	18	18	100
Large	47	43	91.48
Giant	55	44	80.00
Total	120	105	87.50

Tumor Size and Preservation Rates:

- Medium-sized tumors: All 18 cases (100%) achieved anatomical preservation of the facial nerve. This suggests that smaller tumors are more amenable to nerve preservation, likely due to their limited size and less invasive nature.
- Large tumors: Out of 47 cases, 43 preserved the facial nerve (91.48%). While still high, this indicates a slight decrease compared to medium-sized tumors, reflecting increased surgical complexity with larger tumors.
- Giant tumors: Of 55 cases, 44 preserved the nerve (80.00%). The notable drop in preservation rate emphasizes the challenges posed by very large tumors, which often involve extensive dissection and may displace or infiltrate the facial nerve.
- The overall anatomical preservation rate across all tumor sizes is 87.50%, indicating that a majority of patients retain the structural integrity of the facial nerve postoperatively.

Useful hearing preoperatively and postoperatively:

Ten patients had useful hearing pre-operatively. Useful hearing could be retained in eight patients (60%) post-operatively. Amongst these ten patients, one had giant size tumor, four had large tumors and five had medium sized tumor.

Discussion:

Vestibular schwannoma (VS) is a histologically benign Schwann-cell sheath tumor that usually arises from the inferior division of the vestibular nerve 1, 2. VSs arise as a result of the loss of a tumor-suppressor gene on the long arm of chromosome 22. Patients usually present with multiple cranial nerve deficits and signs of brainstem compression or intracranial hypertension 3,4. There are numerous options and factors to be considered in the optimal management of patients with acoustic neuromas 5. The options include microsurgical management; stereotactic radiosurgery and conservative 'wait and scan'6. The decision is based on a number of factors which include the age of patient, size of tumor, preservation of hearing and the presence of co-morbid factors 7. With the availability of operating microscope, safe modern anesthesia and refinement in the microsurgical technique the goal of VS surgery has shifted from complete excision to excellent facial nerve function and preservation cochlear nerve function 8. In this present study, 91.48% and 80.00% of patients had a large and giant sized VS respectively. 75.38% of patients had no useful hearing at time of presentation. In contrast to certain western literature 9,10, 11, majority of our patients sought medical attention at a stage when they developed disabling cerebellar ataxia (84.61%) and /or the symptoms of raised intra-cranial pressure (46.15%). Thirteen patients (10%) underwent ventriculoperitoneal shunt procedure prior to definitive surgery. Eight patients (6.15%) required EVD (External Ventricular Drainage) surgery in the post-operative period. Four patients (3%) underwent Ventriculo-peritoneal shunt procedure after definitive surgery. Complete excision of the VS along with intra-metal portion was achieved in 92.30% (120/130) of patients. Out of the ten patients in whom complete excision could not achieved; Seven patients had tumor adhere to brainstem and in three patients the tumor was adhere to facial nerve (part of the tumor was left to avoid injury). In one patient, only a subtotal removal was possible due to massive intra-operative hemorrhage. Facial nerve anatomically preserved in 87.50% (105/120) patients with complete tumor excision. Ten patients died in post-operative period. The data highlights the correlation between tumor size and the likelihood of preserving the facial nerve (cranial nerve VII) during complete surgical removal of vestibular schwannomas located in the cerebello-pontine angle. The overall anatomical preservation rate across all tumor sizes is 87.50%, indicating that a majority of patients retain the structural integrity of the facial nerve postoperatively.

Tumor Size and Preservation Rates:

- Medium-sized tumors: All 18 cases (100%) achieved anatomical preservation of the facial nerve. This suggests that smaller tumors are more amenable to nerve preservation, likely due to their limited size and less invasive nature.
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- Giant tumors: Of 55 cases, 44 preserved the nerve (80.00%). The notable drop in preservation rate emphasizes the challenges posed by very large tumors, which often involve extensive dissection and may displace or infiltrate the facial nerve.

The decreasing trend in nerve preservation with increasing tumor size underscores the importance of tailored surgical strategies. For medium and large tumors, meticulous microsurgical techniques can achieve high preservation rates. In giant tumors, the surgical goal often balances between maximal tumor removal and nerve preservation, with some cases potentially requiring nerve grafting or reconstructive procedures

Further the functional status of the facial nerve at follow up were better in patients with relatively smaller tumors who had mild grade facial paresis (H&B Grade 1and 2) pre-operatively. Gerganov et al recommended placement of external ventricular drainage (EVD) or VP shunt prior to surgery as surgery in patients with hydrocephalus and increased ICP is presumably more challenging, and related to worse outcome or higher complication rates. They found that the general and functional outcome in patients with primary VS removal is independent of the presence of hydrocephalus 12, 13, 14. Complete tumor excision was achieved in 92.86% (65/70) of the patients. Yamakani et al. reported complete tumor excision in 86% of patients by retrosigmoid approach for large acoustic tumors. Lanman et al reported at higher rate (96.3%) of total removal by trans-labrynthine approach 14. Ebersold et al18 achieved total tumor resection in 97.2% (249/ 256) by retro-mastoid approach for tumors of all sizes. Samii et al have reported complete excision in 97.9% patients by sub-occipital trans-meatal approach 19. The translabyrinthine and retrosigmoid approaches allow removal of VS of almost any size 20. Each approach has advantages and disadvantages. The benefits of the translabyrinthine approach are a short distance to the tumor and avoidance of cerebellar retraction with early identification of the facial nerve. The disadvantages of the translabyrinthine approach include inevitable hearing loss and, in cases of large VS, restricted access to the trigeminal nerve, caudal cranial nerves, and anterior aspect of the CPA 21,22. T

he retrosigmoid approach is the most popular approach among neurosurgeons 23,24,25,26. It is fast, straightforward, and offers excellent visualization of the CPA, trigeminal nerve, lower cranial nerves, and majority of the posterior fossa arteries including the upper part of the vertebral artery and superior cerebellar artery 26.

Anatomical preservation of facial nerve was achieved by 87.50% (105/120) patients. In the giant category facial nerve preservation was 80% (44/55) and in the large category was 91.48% (43/47) and 100% (18/18) for medium size tumors. In some western literatures the anatomical preservation rate is 80-90% with the removal of large tumors either by trans-lybrinthine approach 27,28. Samii and Matthias reported preservation rate of 87% with tumor size 33 cm until 1988, but in most recent 200 cases preservation rate rise to 94% independent of tumor size 27. This data confirms that there is a learning curve for surgery of VS. Microsurgical skills and experience of the surgeon influence postoperative facial nerve function28,29. According to Whittaker et al a surgeon operating less than twelve cases per year cannot expect to get equal results of large series 21. Another major factor influencing facial nerve function is the tumor size. The risk of facial nerve palsy may increase by up to six fold in large VS 29. Facial nerve, having a reciprocal relationship with tumor size i.e. larger size of tumor lesser the chances of preservations facial nerve was also observed in this present study. In the present study ten patients had useful hearing pre-operatively. Useful hearing could be retained in eight patients (60%) post-operatively. Amongst these ten patients, one had giant size tumor, four had large tumors and five had medium sized tumor. Though the retro-mastoid approach gives the surgeon great opportunity for saving hearing in small sized tumors, but in tumors move than 4 cm, the post-operative hearing is usually very poor as observed by Ebersold et al, who reported no post-operative hearing in any of patients with tumor size more than 4 cm 14,15, 18. According to Samii et al, patients with large tumor (30 mm x 20 mm) hearing was preserved in 23.6% (78/330). Almost all authors agree that hearing preservation is more likely with smaller tumors with good pre-operative hearing.29,30. .Although loss of cochlear and seven nerve function are ten of the major cranial nerve injuries that can occur during the surgery, there are risks of injury of lower cranial nerves in large and giant sized tumors, which can complicate the postoperative course. Judicious use of nasogastric tube feeding and planned tracheostomy can avoid major respiratory complications post-operatively. The incidence of lower cranial nerve paresis has been reported to range from 1.5% to 5.5%14,18,35,19 against 7.64% in the present study. Cerebellar retraction is the event with the greatest influence on the surgical risk, and should be avoided.

Appropriate preoperative patient positioning and intraoperative general anesthesia should enable spontaneous retraction.35

Vestibular schwannoma surgery requires continuing refinement and improvement. In the present study, all the cases were operated by retro-sigmoid approach with park bench position. This concludes the fact that the retro-sigmoid approach in experienced hands is a good options; with good results compared to other series irrespective of tumor size. This is an extension to the view put forward by Semii et al that from any of the available approaches, such as sub-occipital, the middle fossa, and the translabyrinthine; surgeons can develop expertise to high standards, by training and experience, with respect to the optimum patient's safety, morbidity and mortality19.

Gormley and Sekhar et al used the combined transpetrosal and retrosigmoid approach for tumors greater or more than 4 cm in the cerebello-pontine angel, especially when they extend up to the tentorial notch, because the combination allows good visualization of tumor-brainstem interface and the tentorial notch and better facial nerve outcome for these group of tumors15. But in our series, using retrosigmoid approach alone visualization of tumor brainstem interface and facial nerve preservation could be possible in giant sized tumors without much difficulty. Although the choice is influenced by surgeons' preferences, the retrosigmoid approach is recommended in surgery for acoustic neuroma whenever hearing preservation surgery is an option, or for tumors of any size irrespective of hearing function36.

Conclusions:

Postoperative facial nerve palsy is a significant and common complication associated with the surgical removal of vestibular schwannomas located in the cerebello-pontine angle (CPA). Due to anatomical relationship, surgical manipulation or tumor dissection can put the facial nerve at risk of injury. Facial nerve palsy can range from mild weakness (House-Brackmann grade II) to complete paralysis (grade VI), affecting facial expression, eyelid closure, speech, and oral competence, thereby impacting the patient's quality of life. The incidence of postoperative facial nerve dysfunction varies depending on tumor size, surgical technique, and surgeon experience, but it remains a key concern in vestibular schwannoma surgeries. Understanding the mechanisms leading to nerve injury—such as mechanical trauma, thermal damage, ischemia, or stretching—and implementing strategies for nerve preservation are critical components of surgical planning and intraoperative management to optimize facial nerve outcomes.

Vestibular Schwannomas tend to be diagnosed late in our local setting, with large tumors and compressive symptoms. The goal in treating VSs should be total removal in one stage and preservation of neurological functions to improve the quality of life for patients. In our experience, this goal can be achieved safely and successfully by using the Retro-mastoid retro-sigmoid suboccipital approach. Achieving anatomical preservation of the facial nerve is feasible in most cases, especially with smaller tumors. Surgeons should consider tumor size during preoperative planning and patient counseling, emphasizing that larger tumors carry increased risks for postoperative facial nerve palsy. Continuous advancements in microsurgical techniques and intraoperative nerve monitoring are vital to improving nerve preservation outcomes across all tumor sizes.

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